Space Weather Technical Forecast

Issued on Monday, 24 June 2024 at 13:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further M-class flares expected, with a slight chance of X-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with peak flare M9.3 at 23/1301 UTC from AR3723 in the southeast. A very long period M-flare, with brief peak at M1.8 was also observed from the southwest limb, likely from AR3712. There are twelve sunspot regions on the disc, with AR3712 now rotated away over the west limb, and AR3713 and AR3716 soon following. AR3723 remains a complex, longitudinally wide, but small in area region, however further details are likely to become apparent as it rotates into view. Some slow growth has also been observed in AR3720, although this is now maturing into a slightly simpler region.

A couple of CMEs have been observed, including a filament eruption off the south-disc, just west of centre, however this forecast to miss Earth, likely passing to the south and west. A further bright CME was also observed from the very long period M-flare, however this was from just over the southeast limb. A further filament eruption has been observed, from the northwest (around 24/0600 UTC), however available coronagraph imagery is currently not sufficient to determine if a CME has been released.

Solar Wind / Geomagnetic Activity: Background slow wind conditions were observed. Solar wind speeds observed by ACE at L1, were at background easing from around 350 km/s to near 300km/s. Density was mostly average or below. Interplanetary Magnetic Field, Bt, was moderate at first around 8-10nT, but gradually eased to be weak at around 2-4nT by 24/1200 UTC. North-south component, Bz, was weak, varying between +8 and -5 nT, and favouring a positive (northward) direction since 24/0000 UTC. Phi angle was predominantly negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 0-3)

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES18 remained at background levels with no solar radiation storms occurring. High energy electron flux (greater than 2MeV) observed by GOES16 was at background. The 24-hour fluence remained below Active, reaching 3.24e6 integrated pfu at 24/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Further M-flares are expected, with a chance of isolated X-class flares, most likely from AR3712, AR3713 or AR3716, though these risks reducing with time.

Solar Wind / Geomagnetic Activity: There are no CMEs currently assessed as Earth-directed, although imagery is awaited to fully assess the filament eruptions on 24 Jun. There is a very slight chance of a glancing interaction from a passing CME on day 4 (27 Jun), due to a southwest disc filament lift on 23 Jun however this is very low confidence. Otherwise solar winds are expected to remain near background with no notable enhancements forecast. Geomagnetic activity is forecast to be mainly Quiet, with only isolated Unsettled intervals. Any CME arrivals later in the period bring a slightly increased risk of Active to G1 Minor Storm intervals.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at

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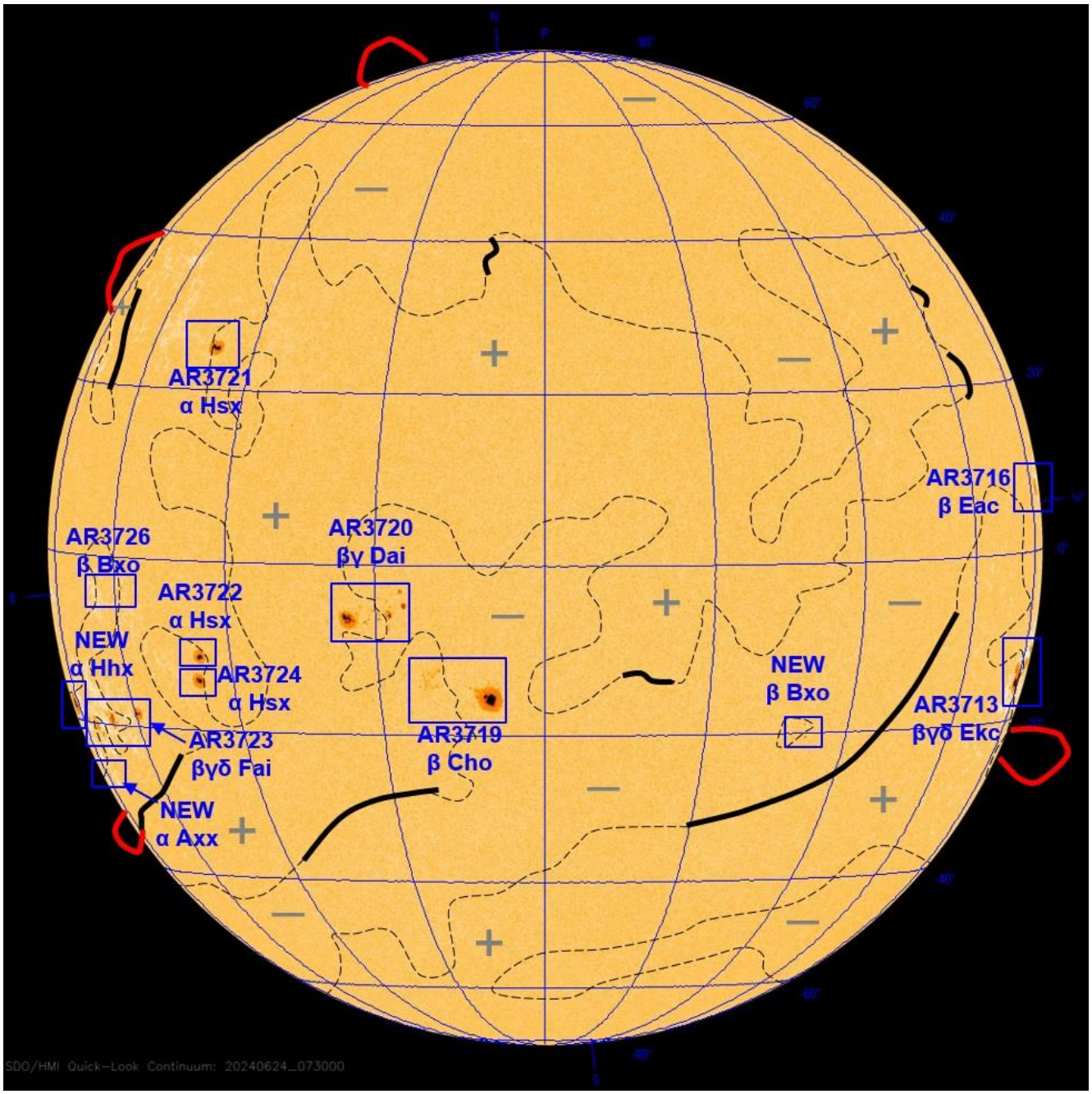
background, but with a chance of exceeding the S1/Minor Storm threshold should any notable flares occur from any of the three large sunspots in the western hemisphere. High energy electron flux is forecast to be at background. The associated 24-hour fluence is expected to remain well below the Active threshold.

Figure 1. Solar Analysis Valid 24/0800 UTC



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are currently no CMEs assessed as being Earth-directed. However filament eruptions were observed off the northwest disc and then the southwest disc early on 24 Jun, and imagery is awaited in order to determine if any CMEs were produced. A further CME from a filament eruption on 23 Jun is also expected to miss just behind and south of Earth, but some weak glancing influence cannot be completely ruled out late on day 4 (27 Jun). Further filament eruption are also possible.

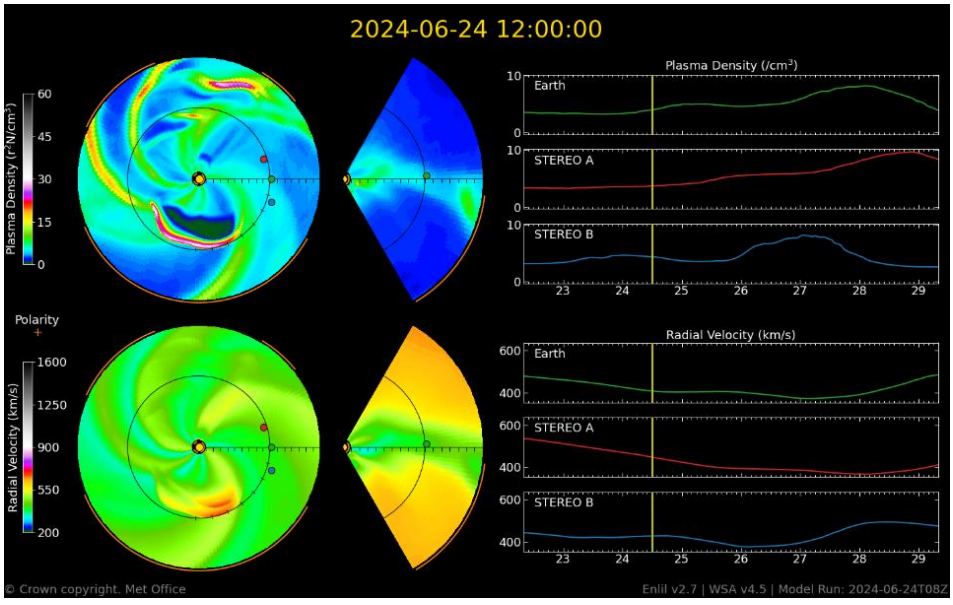
Aside from any CME arrival, solar winds are expected to remain indicative of the slow-wind with no coronal holes of note currently on the Earth-facing disc. Speeds are likely to persist at background. Geomagnetic activity is forecast to be mainly Quiet, with only isolated Unsettled intervals. Any CME arrivals later in the period bring a slightly increased risk of Active to G1 Minor Storm intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Current Enlil forecast



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Radio Blackouts - X-Ray Flares:

Moderate activity is expected through the period, albeit with a decreasing risk due to AR3712/AR3713 and AR3716 soon rotating off the disc. The chance of further M-class flares, and the slight chance of X-class flares is maintained however, mainly due to AR3723 and the surrounding regions rotating onto the east limb.

AR3723, which is likely formed from the remnants of ex-AR3697/3664, along with its surrounding plage area and smaller spots, forms a complex area of notable looping on the southeast disc. While the spot appears rather ragged, and limited in size, there is a clear delta configuration through its intermediate regions. Far-side products also suggest the potential for further spots to rotate onto the disc, although this is low confidence. Nearer the centre disc, AR3720 also has some slight complexity, and ongoing growth, but appears to be maturing into a relatively simple spot.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	80	75	70	60
Very Active	R3 to R5 X Class	No	25	20	15	15

Figure 3a: GOES16/18 X-ray flux

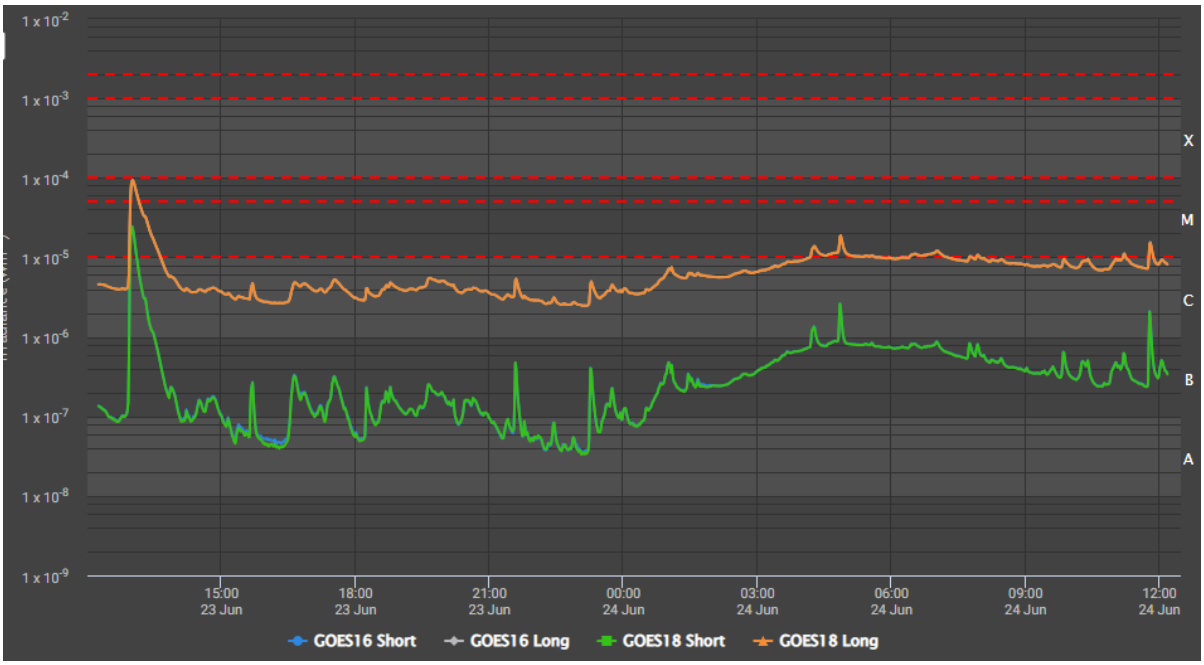

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Figure 3b: SDO imagery of W disc including AR3712/13/16, most of which are over the limb.

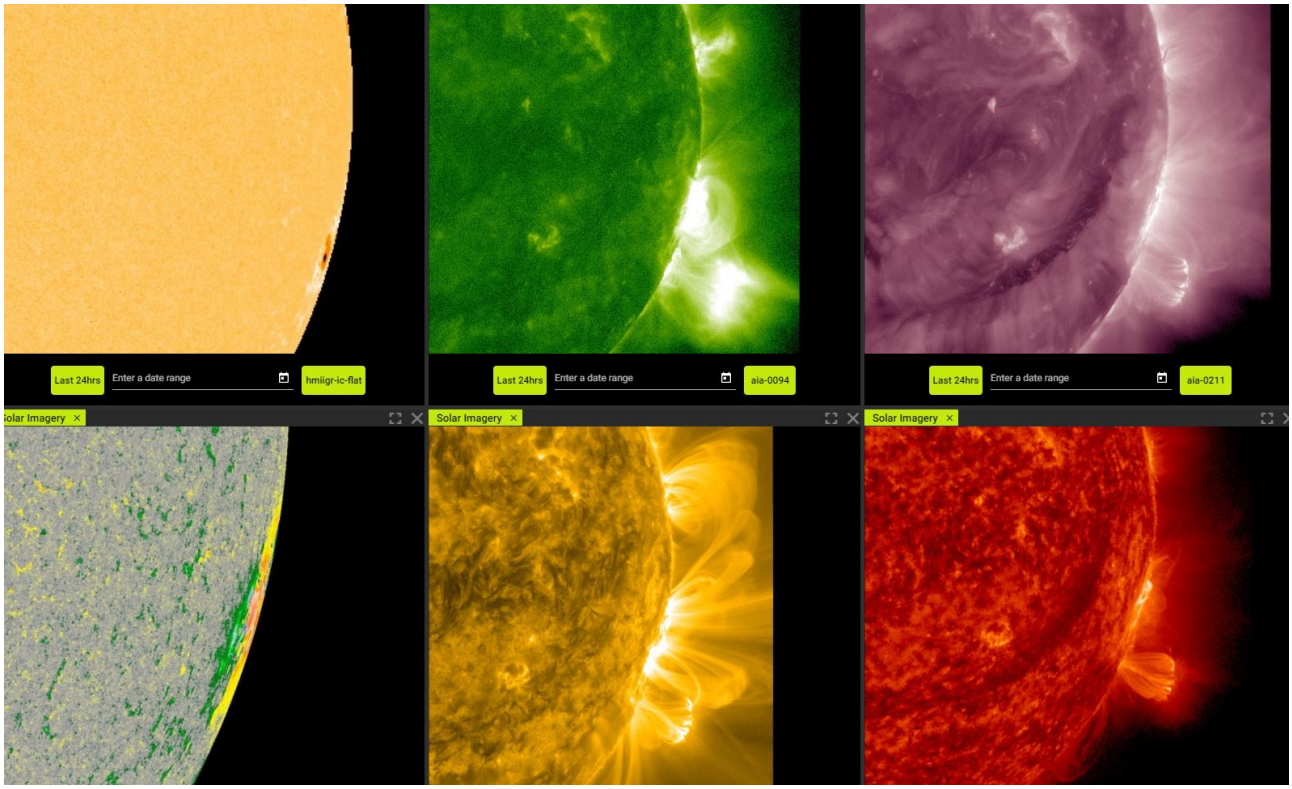
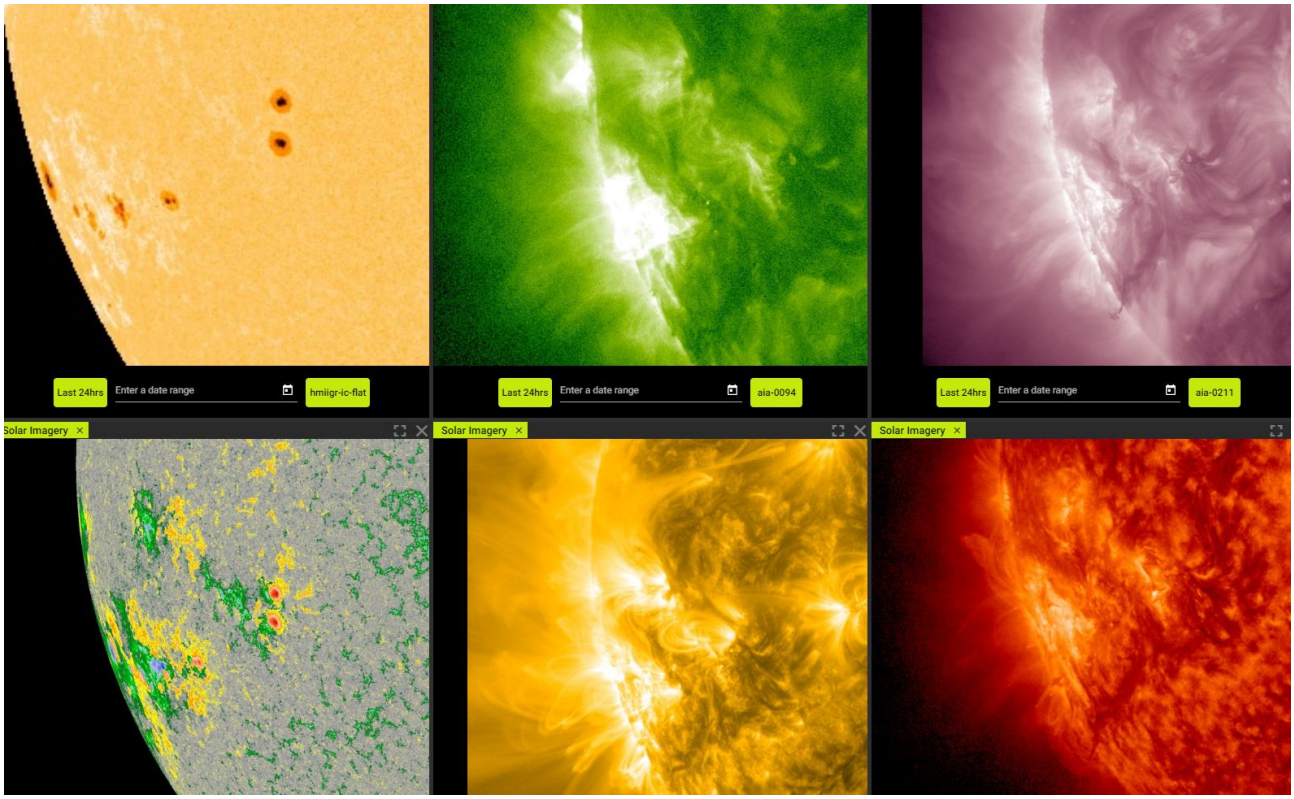


Figure 3c: SDO imagery of SE disc including AR3723, with further regions potentially following.



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Solar Radiation Storms - (High Energy Protons):

GOES-18 high energy protons are at background, and likely to persist at this level. However AR3712, AR3713 and AR3716 are now on the west limb, and each of these provides some potential for proton rich flares, especially the former two. With the west limb well connected to Earth, due to the Parker Spiral, any releases have the potential to be observed at GEO, with a slight chance of reaching the S1 Minor Radiation Storm threshold. This risk receding as these regions retreat further onto the far-side.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	15	15	10	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux, as observed by GOES-16, has been at background. With no notable sources of enhancement forecast, flux is expected to persist at this level.

Associated electron fluence is expected to persist well below the Active threshold (1e8 integrated pfu), with MOSWOC REFM output considered to be good guidance.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	1	1
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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